X.—*On the Anatomy of* Eolis, *a genus of Mollusks of the order* Nudibranchiata. By Albany Hancock and Dennis Embleton, M.D., F.R.C.S.E., Lecturer on Anatomy and Physiology in the Newcastle-upon-Tyne School of Medicine.

[Concluded from p. 10.]

The œsophagus, Pl. I. figs. 4 *c*, 6 and 8 *b*, Pl. II. fig. 9, and Pl. III. figs. 1, 2 and 4 *c*, passes from the posterior dorsal aspect of the buccal mass, and is a much-constricted canal. It is short, longitudinally plicated, and usually bent into the form of an S, so that the apparatus of the mouth can be advanced with facility. It is generally colourless, but in *E. coronata* and two or three other species it is of a deep rosy hue, appearing as a stain of that colour, immediately behind the dorsal tentacles. It consists of longitudinal and circular fibres, the former of which have been noticed in the description of the muscles of the buccal mass. The plicæ seem to be formed by the lining membrane, which we take to be a mucous one, and by the muscular coat.

The stomach, Pl. II. fig. 9, and Pl. III. figs. 1, 2 and 4 *d*, throughout the entire group is a large pyriform pouch which lies diagonally in the body, the lower end approaching the left side; it is continued in the form of a wide, tapering canal, Pl. II. fig. 9, and Pl. III. figs. 1, 2 and 4 *g*, along the median line immediately below the dorsal skin, and terminates near the posterior extremity of the body in a blind sac. From the pouch and its continuation branches are given off in pairs, not however in perfect symmetrical order, but always more or less alternating. These branches give off smaller tubes which are continued into the branchial papillæ. From the upper surface of the posterior extremity of the stomach, just where it is continued into the great central canal, is given off a short intestine, Pl. II. fig. 9, and Pl. III. figs. 1, 2 and 4 *e*, which passes backwards, outwards and to the right side, then running for a short distance along the side, turns outwards and upwards and ends abruptly in a nipple-like anus *f*, generally concealed among the branchial papillæ.

In *E. papillosa*, Pl. II. fig. 9, the anus is situate immediately behind the ninth row of papillæ, and the intestine is considerably dilated a little before its termination: this dilatation is not so conspicuous in other species. In *E. coronata*, Pl. III. fig. 1, the anus is placed amidst the papillæ in the second clump and close behind the fourth row, and in *E. olivacea*, Pl. III. fig. 2, the nipple is seen about midway between the third and fourth rows. In *E. despecta*, Johnst., Pl. III. fig. 4, it is between the first and second branches.

This portion of the digestive apparatus, *i. e.* the intestine and

the anus, appears to have been entirely overlooked by M. de Quatrefages in his *Eolidina paradoxum*, in which he says there is a very small anus at the termination of the central channel. In all the species we have examined we have not been able to detect such an orifice, but have found the true anus and intestine as above described in at least fifteen examples of the *Eolidinæ*.

The stomach, Pl. III. fig. 7, is composed of three coats, a mucous, a muscular, and an external one, which we suppose to be serous. The inner surface of the bulb, of the great central channel, and of the primary and secondary branches, is beset with fine numerous longitudinal rugæ or plicæ, that appear to be formed by projections of the muscular coat covered over by the mucous membrane. In specimens that have been some time in spirits, the mucous coat presents merely a minutely granular appearance; but we have every reason to think that in the living state it is lined with a layer of ciliated epithelium. The muscular coat consists of minute flattened fibres, passing in nearly all directions, the longitudinal and transverse fibres being most distinct. The serous coat appears to be of more homogeneous texture than the others, and much thinner.

In *E. papillosa*, Pl. II. fig. 9, the branches forming the anterior pair arise from about the middle of the dorsal surface of the gastric pouch, and are the only ones which come off anterior to the intestine; they soon bifurcate, the anterior portion is subdivided into four branches, the posterior is continued on without further division; the second pair have their origin in the upper posterior surface of the stomach, and bifurcate like the first pair; the anterior portion remains undivided, the posterior bifurcates: the two anterior pairs of branches however are not always symmetrical, as will be observed by referring to the diagram; indeed we have scarcely seen them alike in any two individuals. The remaining four pairs of branches arise from the central canal, and simply bifurcate. These branches at their origin are all pointed more or less backward; after their bifurcation they incline obliquely forward along the side of the body, lying nearly parallel to each other. From the whole of these branches constricted ducts lead into the interior of the branchial papillæ. In this species there are from twelve to twenty of these ducts given off from each row or branch.

In *E. coronata*, Pl. III. fig. 1, the ramifications of this curious digestive apparatus are somewhat modified. The anterior pair arise from the superior aspect of the lower extremity of the stomachal bulb, close in front of the origin of the intestine, and each trunk passing forward gives off seven branches, the posterior of which is the largest and supplies about seven papillæ. There are five or six other pairs, all of which originate in the

great central trunk, and divide in the same way as the anterior pair, but the branches diminish in number and in size towards the posterior extremity of the body. It may be remarked, that the first and second pairs of branches in this and in most other species are more widely separated than the rest, and in the interval the heart is usually placed.

Another modification is seen in *E. olivacea*, Pl. III. fig. 2; in this species there are six pairs of branches, all of which are simple except the first or anterior pair; these arise as usual from the stomach, and are each divided into three branches. In *E. despecta*, Pl. III. fig. 4, the arrangement is still more simplified: after the branches of the first pair come off in the ordinary way from the stomach and pass on undivided, each to a single papilla, the central trunk passes to its termination in a zigzag direction, giving off a branch at each angle to a large clavate papilla. There are in all four of these papillæ on each side; they are not in pairs however, but alternate.

Other slight variations might be cited, but the above are the chief modifications, and are perhaps sufficient to show to what extent the digestive system varies in the genus *Eolis*.

We have searched in vain for the lateral vessel described by M. de Quatrefages, and have little hesitation in pronouncing its non-existence in the genus. We have seen several species with the ramifications coloured, and in none of them have we observed the slightest indications of such a vessel. In dissecting *E. papillosa* we made every endeavour to detect it, but without success; and in a small specimen of that species we have since seen the very terminations of the branches, and are quite satisfied that they are isolated: the branches mostly ended in free blind sacs of variable length; others had their ends prolonged, bent outwards and received into small papillæ, which seemed to be in process of development; hence we inferred, that the glandular apparatus in the interior of the papillæ was formed originally from the free ends of the branches from the stomach. We are also of opinion that when the animal is mature, the ends of all the branches will be found to enter papillæ. We have observed the termination of branches in papillæ in a species which had their minute ramifications coloured: this species belongs to that portion of the genus of which *E. coronata* is the type. It is therefore probable that M. de Quatrefages has been deceived by the doubling of the skin at the sides of the body, caused by the pressure necessarily used during the mode of investigation adopted by that gentleman: we have seen under such circumstances what might be readily mistaken for a vessel.

The prolongations of the branches from the gastric cavity that are continued into the papillæ are considerably modified in form

in the various species, and from the variety and brilliancy of their colouring form the chief attraction of these very elegant animals. These prolongations appear on a superficial examination to be cæca, but when investigated under favourable circumstances and with a lens, they are found to be tubes with more or less complicated follicular walls, Pl. IV. fig. 9 *a* : the upper extremity of the tube, where the follicular structure ceases, becomes suddenly delicate, transparent and minute, fig. 9 *b*, and is continued on to communicate with a minute ovate vesicle, fig. 9 *c*, which lies within the extreme apex of the papilla, and opens externally by a minute circular foramen, fig. 9 *d*: the inner surface of the follicular or glandular part, which we take to be the liver, is lined with a granular matter.

The simplest form of this peculiar organ is met with in *E. concinna*, Pl. IV. fig. 1. In this species it is a mere dilated tube with its wall slightly waved, and having the inner surface sprinkled with darkish granules. In *E. Farrani*, fig. 2, it still maintains a considerable simplicity of structure, but becomes decidedly sacculated, and with some degree of regularity. The complexity of this organ is however much increased in *E. olivacea*, fig. 3, in which it is deeply and regularly produced into follicles or sacculi, which are much and variously puckered; but in *E. papillosa*, fig. 4, it appears to attain its highest development. The central channel is somewhat tortuous, and gives off on all sides variously sized, irregularly shaped blind sacs, which are crowded with little compound follicles. The whole of the inner surface of this complicated biliary organ is lined with a thickish layer of what appears to be a granular substance through an ordinary magnifier, but which on examination with the microscope is found to be composed of large irregular vesicles or globules, Pl. V. fig. 7, disposed without any manifest arrangement, and filled with numerous granules. These last when submitted to a still higher magnifying power are seen to be transparent, rounded, and of various sizes, and nucleated, fig. 8. The larger bodies or globules have a diameter of $\frac{1}{1500}$th of an inch. The largest of the granules measure about $\frac{1}{3000}$th of an inch in diameter.

The compound follicular nature of this gland is best observed in the living papilla fresh plucked from the animal, and submitted to a slight action of the compressor. In papillæ that have been some time in spirits the gland is somewhat contracted, its divisions approximated, and thus a more uniform surface of follicles is presented.

In describing this gland or liver M. de Quatrefages has the following passage: "Mais les cæcums qui partent des branches de l'intestin pour pénétrer dans les cirrhes s'entourent, en entrant dans leur cavité d'une espèce de fourreau irrégulier formé

d'une substance granuleuse bien moins transparente que le reste des tissus. Il m'a semblé reconnaître en outre l'existence de très petits orifices s'ouvrant dans l'intérieur du cæcum." Now in the numerous species we have examined, we have seen nothing to warrant the idea here laid down. From our statement above it will be seen, first, that we believe these prolongations of the branches of the digestive cavity not to be cæca, and secondly, that they are not simple tubes having a granular substance *coating* them, but we find that the walls of the tubes are more or less bulged or thrust outwards into the form of simple or compound follicles, and that the walls are *lined* throughout by the granular matter we have already described; in fact, that each papilla contains a perfect gland of distinctly follicular type. Pl. IV. fig. 5. shows a longitudinal, and Pl. IV. fig. 7. a cross section of a papilla of *E. papillosa*; *a* in each represents the great central channel from which on all sides branch off large canals that end in small imperforate diverticula.

The whole internal surface of this compound gland is furnished with minute vibratile cilia, as likewise the small canal that leads to the oval vesicle; the cilia do not appear to be continued into the vesicle. We have however seen, on examining these parts under pressure, small granules which had accidentally passed into the tube, driven by the ciliary motion into the vesicle.

Having described the glandular apparatus, we now pass on to the vesicle at the extremity of the papilla. This vesicle is of an ovoid form; its long diameter in the largest specimens measures about $\frac{3}{200}$ths of an inch, its narrow end lying within the very apex of the papilla; both ends are perforated; the narrow end opens externally through a round aperture in the skin covering the apex of the papilla, the opposite extremity communicates with the gland by means of the slender tube, of variable length, which has already been noticed.

The walls of the vesicle, which are seen of an opake white in those species which have transparent skin, is fused with the integument of the papilla round the external orifice; and below this stout muscular bands, Pl. IV. fig. 9 *e*, attach the vesicle to the skin, so that during the contractions of the papilla the vesicle is held secure in its position. In *E. papillosa* the wall of the vesicle, Pl. V. fig. 12, consists throughout of a strong thick layer of finely interwoven circular muscular fibres. The contents appear to be arranged in longitudinal masses, as represented in the longitudinal section, Pl. V. fig. 1, which in a cross section, Pl. IV. fig. 8, have a triangular outline, the apices not quite reaching the axis of the vesicle. There is therefore a free space corresponding to the long axis. If we take out a portion of the contents of the vesicle and place it under the $\frac{1}{8}$th-inch object-glass of the micro-

scope, we find it to consist of numerous transparent, long, narrow, slightly bent, elliptical bodies, Pl. V. fig. 11, having a double longitudinal faint marking extending from one end nearly to the other; and globules of various sizes, Pl. IV. fig. 6, containing either one nucleus or several small granules in their interior. These are imbedded and adhere to a tenacious, obscurely granular mucus-like matter. The largest elliptical bodies measure in length $\frac{5}{1000}$ths of an inch, the smallest $\frac{1}{2000}$th of an inch. The largest globules have a diameter of $\frac{1}{4500}$th of an inch.

On placing a papilla recently severed from the living *E. papillosa* in a compressor, and establishing a slight degree of pressure, there were observed to be ejected at intervals from the terminal orifice, little transparent ellipsoidal membranous bags, Pl. V. fig. 9, containing half a dozen or more of the elongated bodies already spoken of. Immediately after expulsion most of these bags burst, and the contained bodies becoming scattered, each shot forth from the end that first appeared a slender hair-like filament, fig. 10 *a a*, with astonishing velocity to a length far exceeding the diameter of the field of the microscope. Other bags did not become ruptured till a second or two after their expulsion; from these the filaments proceeded very slowly and in a perfectly regular serpentine line, so that their advance could be followed by moving the stage of the microscope, and was observed to resemble closely the progression of many small Annelida. These filaments becoming stationary retained a serpentine form, fig. 10 *b b*; other filaments were minutely spirally twisted at their junction with the elliptical body, fig. 10 *c c*. The faint double line seen in the interior of the elliptical body we suppose to be the part that contains the filament.

The elliptical bodies pressed out from papillæ which had been in spirits were never observed to emit filaments; we presume therefore that this phænomenon is a vital manifestation.

These bodies we find to differ in form in different species: thus in *E. coronata*, Pl. V. figs. 2 and 3, they are slightly bent, but shorter and thicker than in *E. papillosa*, and enlarged at their posterior extremity; they are provided with a similar filament at one end.

The bags, fig. 6, contain a considerable number of these, and also numerous other bodies of much larger size, of elliptical form, flattened and transparent, but having in their interior a peculiar marking which is represented in fig. 5. In *E. olivacea* the bodies with filaments, fig. 4, are rather stouter, but strongly resemble those of *E. coronata*.

On several occasions we have witnessed the expulsion of these bodies from the living animal, which at the time was suffering slight pressure, so slight indeed that the animal was able to move

its papillæ, and in one instance an *E. Drummondi* crawled from one side of the compressor to the other. The expulsion was effected by the walls of the vesicle, and recurred at intervals; small masses of the bodies were ejected with considerable force, and to some distance. We do not feel ourselves at present in a position to decide upon the true nature of these bodies, but we may say that they resemble Spermatozoa more than anything else; we may add, that we have obtained bodies to all appearance Spermatozoa from the genital organs of *E. papillosa*, which differed only from those obtained from the papillæ in being more rounded as to their bodies, and altogether inferior in size. They are shown in Pl. V. fig. 13, as seen under deficient magnifying power.

We shall now revert to the follicular gland of the papilla. We think there can be no doubt of its being a secreting organ pouring its secretion into the digestive cavity, and we agree with M. de Quatrefages in the opinion that the entire series of these glands represents the liver, which in the Mollusca is characteristically large, but in the *Eolidinæ* has disappeared from the abdominal cavity. The central canal of the gland opens inferiorly by a short duct, Pl. IV. figs. 2, 3, 4 *a*, into one of the ramifications of the digestive cavity, and superiorly by the delicate canal before described into the ovate vesicle. We have no doubt that by the lower opening the secretion of the gland finds its way into the gastric ramifications; but as to the nature of the communication or connexion between the gland and the ovate vesicle, we confess our entire ignorance.

To give a general idea of the digestive apparatus, we should say that the compound follicles of the papillæ represent the liver; the small tubes leading from them are their ducts, by which their secretion is carried into the gastric organ consisting of the pyriform pouch, the great central canal, and their main branches.

In some species however the structure and functions of the several parts seem somewhat modified. In *E. despecta* the central canal, all the ramifications and the glands of the papillæ are coloured and granulated alike; it is therefore probable that the whole of these parts perform the same function. The stomach and intestine are the only parts that are transparent in this remarkable species. In *E. gracilis*, *E. rufibranchialis*, *E. Northumbrica* and others, either the extremity of the great central canal or the ends of the lateral ramifications are slightly coloured like the glands of the papillæ.

This view of the matter is somewhat corroborated by what is observed to take place during digestion. The food enters the stomachal bulb in large masses, and is there broken up and mixed

with the fluids of the digestive cavity. In this state it is driven throughout the alimentary system by the alternate contractions of the pyriform pouch and the great trunks leading from it. These contractions are only of a nature to produce an oscillatory motion which serves to promote that intimate mixture of the alimentary matters with the hepatic and other secretions necessary to the process of digestion.

We have watched this action with great care in *E. coronata*, and have observed on several occasions in individuals that were free and moving about at pleasure, and in which the action of the parts was natural, currents passing rapidly backwards and forwards through the stomach, and larger ramifications obeying the various contractions of the parts, and holding in suspension large, crude, irregular particles varying in size and shape. We had the satisfaction also to see more than one individual take its food, which we have found to be always of an animal nature, and could perceive the lumps as they were lopped off by the jaws pass along the œsophagus and enter the stomach. We have likewise frequently seen the track of the *true* intestine marked out by the dark colour of the fæces it contained, and have witnessed also the expulsion of the same from the anus.

M. de Quatrefages supposes that the refined products of digestion pass into the branchial cæca as he terms them, and also into the ovoid vesicle, though in the latter he has seen no floating corpuscles. Through the walls of the cæca, and especially through those of the vesicle, he believes that the chyle for the support of the body transudes. Again, he makes the branchial cæca surrounded by a granular mass performing the office of liver, thus cumulating in the same organ function upon function. We have already stated that we agree with M. de Quatrefages in taking the glands of the papillæ, as we term them, to represent the liver, and we now subjoin, that we see no reason to believe them to be also the organs by means of which the chyle is conveyed from the digestive to the circulatory system. We have ourselves seen crude particles of the alimentary matters mixed with regular corpuscles pass into the glands of the papillæ, and on one occasion even a large angular fragment was forced through the narrow duct at the base of a gland, entering its cavity and afterwards passing out again. But in all these cases, our specimens, as well as those of M. de Quatrefages, were suffering considerably from the action of the compressor, and consequently the fluids of the stomach and other parts may have been forced into unnatural channels. We do not put much faith in examinations conducted in this way, and indeed the only satisfactory method of investigating this subject is to watch the progress of digestion when the

animal is moving freely about; and until this be done, all theorizing appears to us idle, and likely to lead to error and confusion.

Salivary glands.—These in *Eolis* are very small and difficult to detect; they lie concealed between the corneous plates and the muscular mass of the cheek, as previously noticed. On removing either of the corneous plates in *E. papillosa*, the gland will be found lying exposed in a depression on the upper third of the external surface of the cheek-mass, corresponding to about the centre of the corneous plate, Pl. III. fig. 6 *a*. The gland is composed of a small cluster of roundish, yellow, irregular follicles, fig. 5, and frequently a little way in advance of this there is a smaller one made up of two or three follicles. The two parts are connected by a long slender duct, which passing backwards opens into the mouth at the commencement of the œsophagus. We have likewise detected this gland in *E. coronata*.

This gland differs conspicuously in size, position and character from the same organ in *Eolidina*, figured and described by M. de Quatrefages. All we can say is, that in our researches we have observed nothing like the representation given by him of the salivary glands of that species. It is certainly not likely that in animals so closely allied these organs should be so widely different. We would suggest therefore the possibility of that naturalist having mistaken some portion of the generative organs for them. We are inclined to do this the more since he has entirely misunderstood the sexual apparatus, and figured and described only a small portion of it, and since we have sometimes observed, when examining these animals in the compressor, portions of that apparatus not altogether unlike M. de Quatrefages' figure of the salivary glands of *Eolidina paradoxum*.

Since writing the above, we have had much satisfaction in gathering from the Observations of M. Souleyet on the Gasteropod Mollusca, forming the proposed order *Phlebenterata* of M. de Quatrefages, translated in the November Number of the 'Annals,' that our views have been almost altogether verified.

With respect however to the anatomy of the gland of the papillæ, M. Souleyet appears to adopt the opinion of M. de Quatrefages, who states that the prolongation of the digestive cavity into the papilla is *coated* with a granular layer—the liver. We have shown above that this view is inaccurate, and in confirmation of this we may as well state, that on the papillæ being subjected to pressure, the granular structure of the gland invariably becomes ruptured internally; but if the view taken by these gentlemen be correct, we should apprehend that the rupture would take place externally into the vascular canal surrounding the gland.

EXPLANATION OF THE PLATES.

Plate I.

All the anatomical figures in this plate are from *E. papillosa*.

Fig. 1. *Eolis papillosa*, Johnst., a little above natural size.

Fig. 2. *E. coronata*, Forbes, nearly double natural size.

Fig. 3. *E. olivacea*, Alder and Hancock, four times natural size.

Fig. 4. Section of the lips with buccal mass attached: *a*, outer lip; *b*, inner lip; *c*, œsophagus; *d*, corneous plates of buccal mass; *e*, channel of mouth; *f*, circular belt of muscle at the attachment of outer lip; *g g*, muscles passing from the circular belt to foot and skin of head; *h*, muscular bands passing from circular belt to posterior margin of horny plates; *i*, foot.

Fig. 5. Vertical section of buccal mass, showing the muscles of the tongue, the external layer being removed: *a*, muscle which assists in rotating tongue forwards, arising from upper margin of horny plate, and passing downwards to inferior surface of *b*, muscle which rotates the tongue backwards, being inserted by its ends into the posterior end of tongue and into the inferior extremity of cutting blades *e*; *c*, muscle attached to both ends of tongue, which it will approximate; it will also assist *a* in rotating the tongue forwards; *d*, strong layer of short transverse muscles which bind together the external layers of muscle, and form a fulcrum for the semicircular rotators; *f*, œsophagus; *g*, corneous plates; *h*, ridge of the tongue; *i*, cutting-jaws; *k*, the hinge or fulcrum of horny plates; *l*, anterior extremity of muscular cheek-mass.

Fig. 6. Nearly vertical section of buccal mass: *a*, horny plate; *a'*, cutting-edge; *b*, inner lip; *c*, hinge or fulcrum; *c'*, transverse muscles that close the jaws; *d*, transverse muscles that open the jaws; *e*, inferior transverse muscles that assist in closing the jaws; *f*, wedge-shaped mass of tongue, supporting spiny ridge and showing the two external layers of muscles; *g*, muscular cheek-mass; *h*, fold of lining membrane of mouth; *i i*, outer lip; *k k*, circular muscular belt at base of outer lip; *l*, œsophagus.

Fig. 7. Upper aspect of buccal mass: *a a*, corneous plates; *b*, muscular bands on the external surface; *c*, œsophagus; *d*, transverse muscles before fulcrum; *e*, transverse muscles behind fulcrum; the dark line between the two sets of muscles indicates fulcrum; *f f*, muscles arising from upper part of horny plates, and passing down behind mass of tongue marked *a* in fig. 5.

Fig. 8. View of cavity of buccal mass from above, the fulcrum being divided, and the horny plates *a a* drawn apart; *a' a'*, cutting-edges of jaws; *b*, inner lip; *c*, spiny ridge of tongue; *d*, wedge-shaped muscular mass of ditto; *e*, muscular cheek-mass; *f*, flat upper border of ditto; *g*, anterior attachment of ditto to cutting-jaws; *h*, folds of lining membrane of mouth; *i*, fulcrum of horny plates; *k*, anterior and posterior transverse muscles; *l*, œsophagus.

Fig. 9. Upper aspect of buccal mass with superficial muscles removed: *a a*, corneous plates; *b*, triangular process forming fulcrum; *c*, cutting-edges of horny plates; *d*, ridge dividing surface of fulcrum into anterior and posterior parts; *e*, muscle of left side which passes down to be attached below to tongue-mass, fig. 7 *f f*; *f*, thin layer of muscular fibres which pass from edge of horny plate, converging to form longitudinal fibres for œsophagus, *g*.

Fig. 10. Lateral aspect of buccal mass obliquely viewed, with part of the muscles removed: *a*, exposed surface of corneous plates; *b*, poste-

rior transverse muscles to open jaws; *c*, anterior ditto to close jaws; *d*, inferior ditto to close jaws.

Fig. 11. Same view as fig. 10: *a*, corneous plates; *b*, muscles of inner lip; *c*, inner lip.

Plate II.

All the anatomical figures in this plate are from *E. papillosa* unless otherwise stated.

Fig. 1. Two views of transversely arched plates from ridge of tongue, magnified, to show the spines.

Fig. 2. Anterior aspect of buccal mass, with lips and lateral muscles removed: *a*, cutting-edges of jaws; *b*, superior anterior transverse muscles; *c*, inferior ditto; *d*, tongue appearing between cutting-blades.

Fig. 3. Lateral view of buccal mass of *E. coronata*.

Fig. 4. Muscular cheek-masses inclosing *a*, the tongue; the horny plates have been removed; *b*, flat upper free border of masses; *c*, anterior pointed extremity of muscular masses attached to lower end of cutting-blades; *d*, œsophagus.

Fig. 5. External lateral view of horny plate, all muscles removed: *a*, ridge giving origin to muscles of inner lip; *c*, portion of same giving origin to muscles of outer lip; *b*, cutting-blade.

Fig. 6. Same view of horny plate of *E. coronata*.

Fig. 7. Interior view of horny plate of *E. papillosa*: *a*, fulcrum or hinge; *b*, cutting-blade; *c*, line dividing the origin of the anterior and posterior superior transverse muscles.

Fig. 8. Front view of horny plates of *E. coronata*.

Fig. 9. Digestive apparatus of *E. papillosa*, the glands of the papillæ removed: *a*, buccal mass; *b b*, corneous plates of same; *c*, œsophagus; *d*, bulb of stomach; *e*, true intestine; *f*, anus; *g*, great central canal leading from stomach and ending posteriorly in a blind sac; *h*, a primary branch from digestive cavity; *i*, secondary branches; *k*, ducts from glands of papillæ.

Fig. 10. Teeth of *E. nana*.

Fig. 11. Spiny ridge of tongue of *E. alba*.

Fig. 12. Upper aspect of three plates of same.

Fig. 13. Portion of spiny ridge of *E. olivacea*.

Fig. 14. Upper aspect of two plates of same.

Plate III.

Fig. 1. Digestive apparatus of *E. coronata*; the letters correspond to those of fig. 9, Pl. II.

Fig. 2. Digestive apparatus of *E. olivacea*; letters as above.

Fig. 3. Upper aspect of two plates of spiny ridge of tongue of *E. nana*.

Fig. 4. Digestive apparatus of *E. despecta*; letters as in fig. 9, Pl. II.

Fig. 5. Salivary gland and duct of *E. papillosa*, highly magnified.

Fig. 6. Lateral view of buccal cavity and cheek-mass of *E. papillosa*, one horny plate removed: *a*, salivary gland; *b*, horny plate; *c*, part of cheek-mass attached to horny plate; *d*, flattened upper border of cheek-mass; *e*, anterior extremity of cheek-mass passing to its attachment to inferior points of cutting-blades; *f*, free part of external surface of cheek-mass.

Fig. 7. Stomach of *E. papillosa* laid open, showing rugæ of internal surface of bulb, central canal, primary and secondary branches.

Plate IV.

Fig. 1. Papilla with gland of *E. concinna*.

Fig. 2. Papilla with gland of *E. Farrani.*
Fig. 3. Ditto ditto of *E. olivacea.*
Fig. 4. Ditto ditto of *E. papillosa.*
Fig. 5. Longitudinal section of papilla of *E. papillosa,* showing interior of gland, &c.: *a,* great central channel; *b,* diverticula therefrom.
Fig. 6. Globules from ovate vesicle, highly magnified.
Fig. 7. Transverse section of gland of papilla of *E. papillosa*: *a,* great central vessel; *b,* diverticula from it.
Fig. 8. Transverse section of ovate vesicle.
Fig. 9. Highly magnified representation of a papilla of *E. papillosa*: *a,* the gland; *b,* fine vessel leading from gland to ovate vesicle *c*; *d,* orifice at apex of papilla; *e,* muscles attaching vesicle to wall of papilla; *f f,* external wall of space in which the blood circulates in contact with the external surface of the gland; *g g,* muscular bands inclosing cellular spaces between *f f* and the skin of the papilla; *h,* skin of papilla; *i,* vibratile cilia on external surface of ditto; *k k k,* circular and longitudinal muscular fibres of skin.

Plate V.

Fig. 1. Longitudinal section of ovate vesicle.
Figs. 2 and 3. Spermatozoid bodies from ovate vesicle of *E. coronata.*
Fig. 4. Spermatozoid bodies from ovate vesicle of *E. olivacea.*
Fig. 5. Elliptical bodies inclosed in bags or utriculi with the spermatozoid bodies of *E. coronata.*
Fig. 6. Utriculus or bag from ovate vesicle of *E. coronata,* containing the two kinds of bodies mentioned under fig. 5.
Fig. 7. Vesicles or globules containing granules from the gland of papilla of *E. papillosa.*
Fig. 8. The granules more highly magnified.
Fig. 9. Utriculi from ovate vesicle of *E. papillosa,* containing the spermatozoid bodies.
Figs. 10 and 11. Spermatozoid bodies from same: *a a a a, b b, c c,* different appearances presented by the filaments or tails of the spermatozoid bodies of *E. papillosa.*
Fig. 12. Part of a transverse section of the wall of ovate vesicle of *E. papillosa,* showing the interlacing muscular fibres.
Fig. 13. Spermatozoa from generative organs of *E. papillosa.*
Fig. 14. Anterior view of *Eolis papillosa* from spirits: *c,* cutting-jaws; *b,* inner lip; *d,* folds of lining membrane, &c. of channel of mouth; *e,* outer lips; *f,* fold of integument external to outer lips; *g,* labial tentacles; *h,* dorsal tentacles; *i,* anterior margin of foot.
Fig. 15. Inferior view of head of *Eolis olivacea* in its natural state. The letters in this fig. as far as they go are as in fig. 14.
Fig. 16. General view of viscera, &c. of *Eolis papillosa* from above, the dorsal skin alone having been removed: *a,* buccal mass; *b,* cerebral ganglia with the nerves passing off from them; *c,* ganglia at the base of dorsal tentacles, supposed to be olfactory; *d,* œsophagus; *e,* stomachal bulb; *f,* great central canal; *g g g,* primary and secondary branches from ditto; *h,* true intestine; *i,* anus; *k,* portions of male generative organs; *l,* ovarium; *m,* ventricle of heart, with aorta passing forwards from it; *n,* auricle of heart.